national accelerator laboratory

EXP-30

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ACCELERATOR EXPERIMENT--Experiment to Check Proton Split Bump MVT90

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THEORY

The Proton-Neutrino beam split is accomplished by first dividing the proton beam vertically with two electrostatic septa (PES) and then horizontally deflecting the Proton Lab. beam with magnetic septa (PLAM) downstream from the PES. The PES consists of a single ground plane of tungsten wires .002" in diameter with solid cathodes 1 cm from either side of the wires so that the split beams are deflected 0.12 mrad up and down respectively.

In the mode of running which sends beam to the dump or Neutrino Lab. exclusively, the beam traverses the PES 0.130" below the wires. To split the beam, there is a pair of bump magnets, MVT90 and MVT91, which, with help from the quadrupole doublet (MQ90-91), produces a parallel displacement of the beam incident at the PES. If there were no difficulty in doing so, the parallel displacement could be accomplished simply with two bumps equal in magnitude but opposite in direction. Because of space limitations, the upstream bump is placed upstream of MQ90-91 and the downstream bump is downstream. Overall, the quadrupole doublet has vertical focussing which is taken into account by putting only 60 turns of MVT91 in series with 140 turns of MVT90. This ratio of 60 to 140 turns plus the quadrupole steering should make a displacement which is parallel to .0036 mr for the nominal 0.1 mrad deflection needed for a 50-50 split.

To slightly adjust the angle the beam makes with the wires in the septa, 20 turns each on MVT91 and MVT92 (after the septa) are connected to produce a dog leg across the PES. In principle, this bump combination (called MVT91) can be used to make the beam parallel after it is positioned on the wires with the MVT90, MVT91 combination, which is referred to as MVT90. Finally, there is the third magnet, MVT92, which has 120 turns which are used to cancel the 0.12 mrad upward deflection of the Proton Lab. beam. Obviously, it is important to check the performance of these bump combinations before significant running can be accomplished.

APPARATUS AND DATA

The MVT90 bump was powered with MQ90-91 off and on. Under these conditions, the beam position on each of four SWIC's was recorded. The positions of the SWIC's and magnets is shown in Figure 2. Data were taken at 0, 15 and 30 amps in MVT90. The data are given in Table I. The data are plotted in Figure 1 where it is noted that the displacement is consistent with being linear. Graphs (a) and (b) are the same since the quadrupole doublet has no effect upstream of itself! Graphs (b) and (f) are very similar as there is a rather short lever arm for MQ90-91 to produce any noticeable deflection. There is clear evidence that MQ90-91 has a focussing effect in graphs (c) and (g) and (d) and (h). Further, when the MVT90 bump is turned off, there is no quadrupole steering; both (c) and (g), and (d) and (h) have the same intercept.

The numbers in parentheses in Table I result when the MVT90 off positions at each SWIC are subtracted from the I = 15 and 30 amp positions. These data are plotted in Figures 2 and 3 where the effects of the MVT90 magnet and the quadrupoles are apparent. Also plotted are the theoretical expectations. The data do not seem to agree downstream of MVT91.

CONCLUSIONS

Since the data downstream of MVT91 do not go as predicted,

one suspects something is wrong with MVT91. Perhaps there are fewer than 60 turns in series with MVT90 or perhaps the magnet has some shorted turns. Further investigation is necessary.

H. E. Fisk

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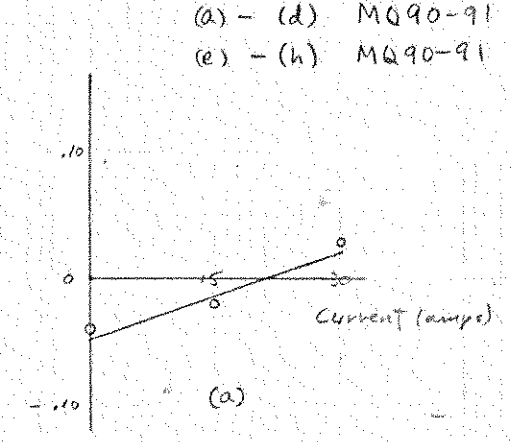
Current (amps)			Position (inches)			
MVT90	MQ90-91		MQ90 SWIC	PSEP SWIC	B400 SWIC	B600 SWIC
0	0		-.04 (0.00)	-0.18 (0.00)	-0.32 (0.00)	+0.22 (0.00)
15	0		-.02 (0.02)	-0.11 (0.07)	-0.11 (0.22)	+0.58 (0.36)
30	0		+.03 (0.07)	-0.04 (0.14)	+0.17 (0.50)	Off Scale
0	54		-.05 (0.01)	-0.18 (0.00)	-0.32 (0.00)	+0.22 (0.00)
15	54		-.02 (0.02)	-0.12 (0.06)	-0.17 (0.15)	+0.45 (0.23)
30	54		+.03 (0.07)	-0.03 (0.15)	0.00 (0.32)	+0.65 (0.43)

Table I

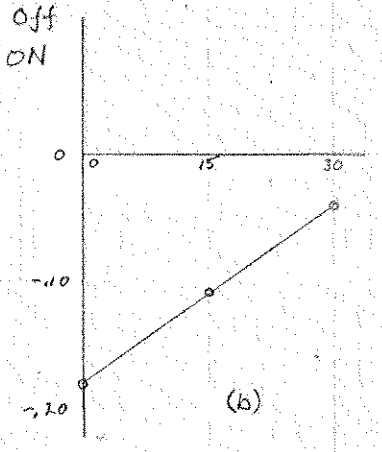
Beam Position vs. MVT90 Bump Current Date

BEAM POSITION vs. MVT90 CURRENT

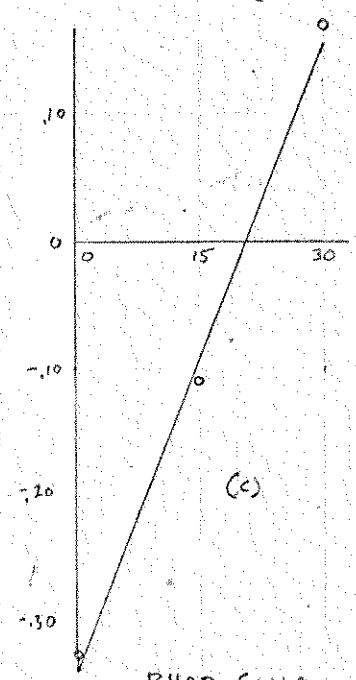
(a) – (d) MQ90-91 off
(e) – (h) MQ90-91 ON



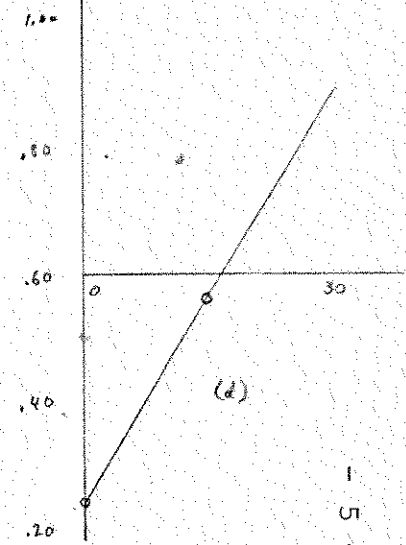
(a)



(b)



(c)



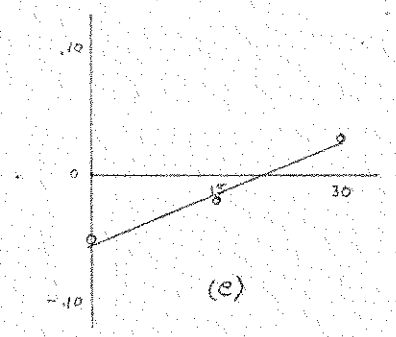
(d)

MQ90 SWIC

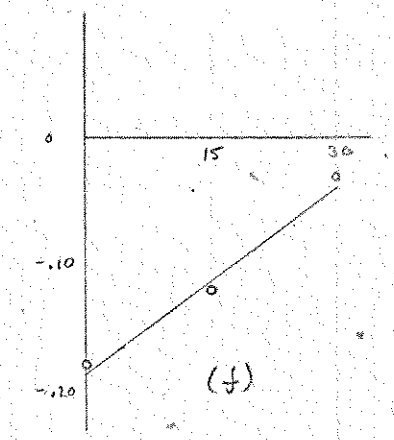
PSEP SWIC

B400 SWIC

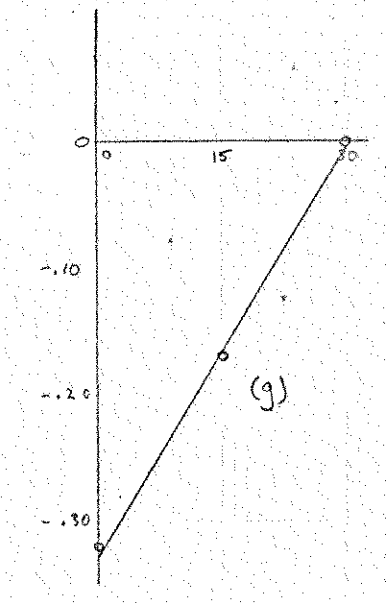
B600 SWIC



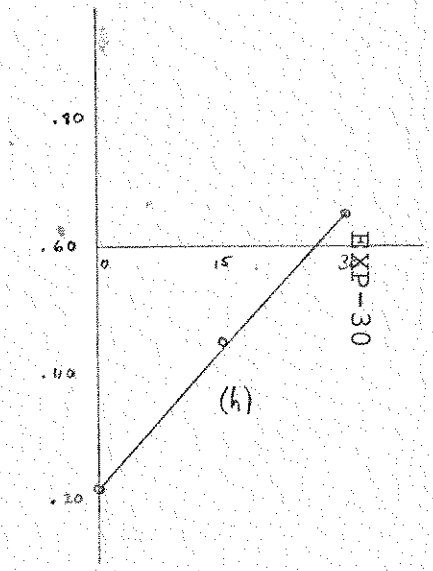
(e)



(f)



(g)



(h)

Fig 1

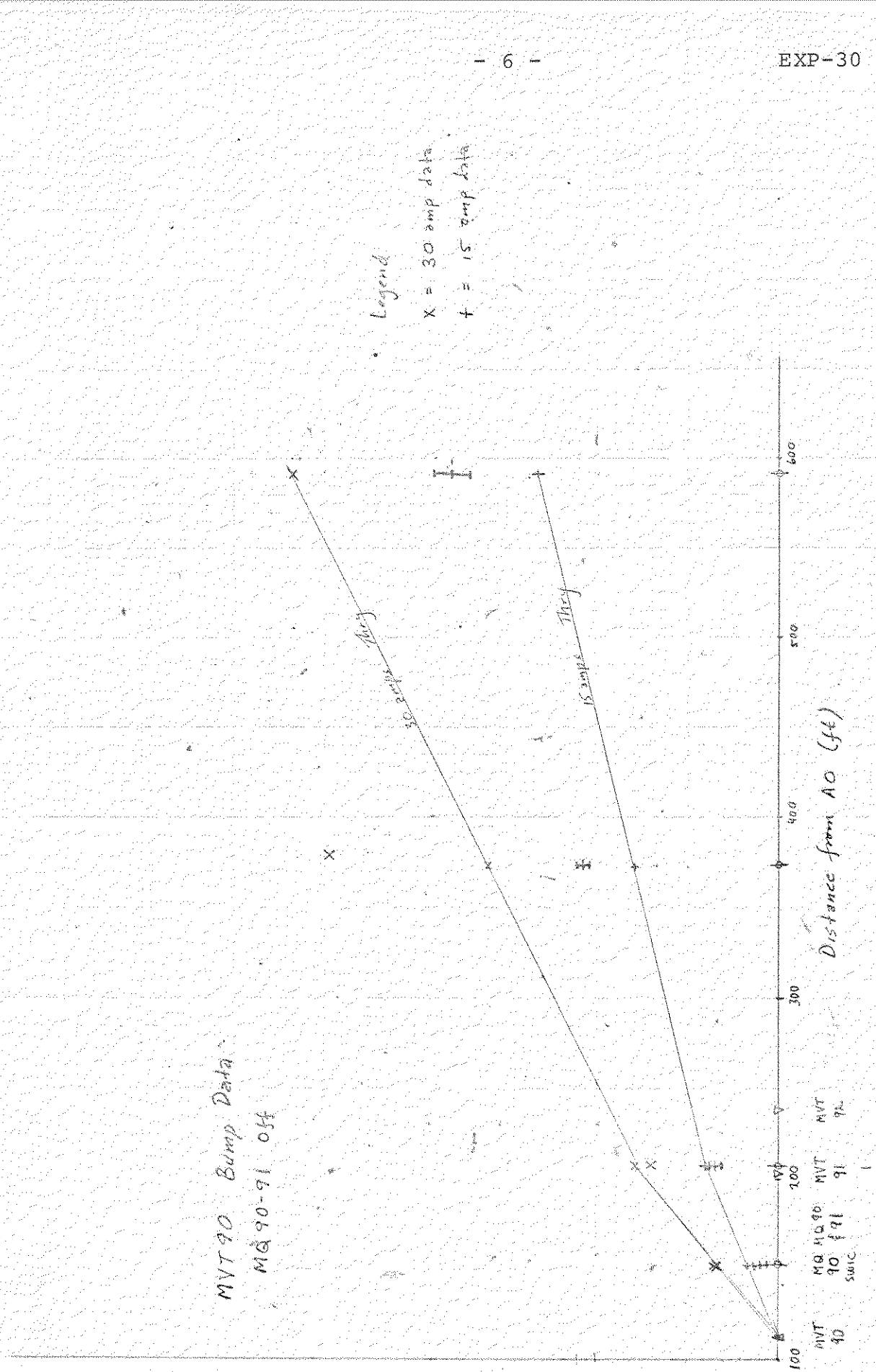

MVT90 Bump Data
MQ90-91 044
Inches Displacement from $\bar{I}_{MVT90}$ = 0 Beam
Distance from A0 (ft)
Legend
X = 30 amp data
+ = 15 amp data
1st bump
2nd bump
MVT 90
MQ MQ90 MVT 91
90 E91 SWIC
PSCP
SWIC

Fig 2

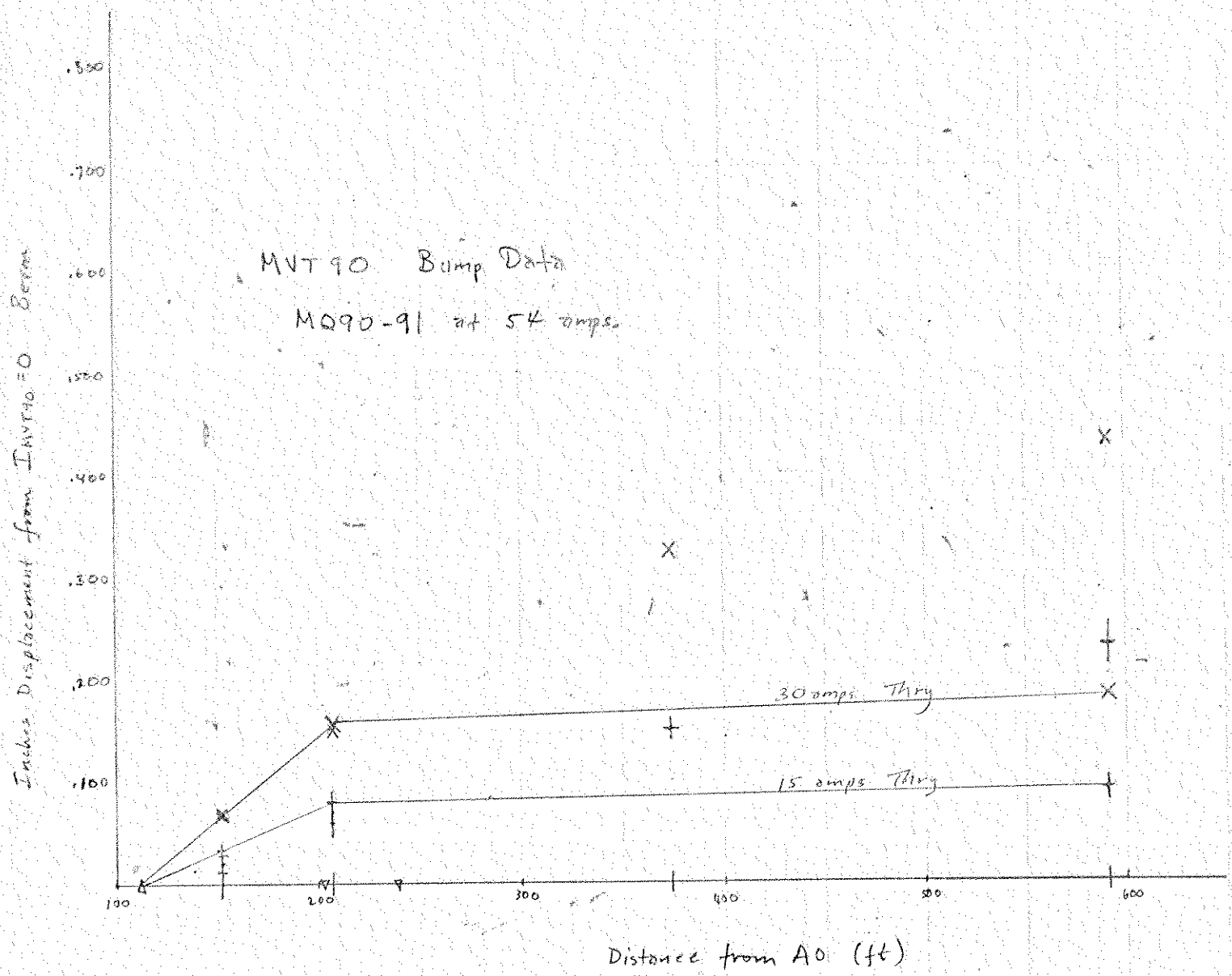

MVT 90 Bump Data
MQ90-91 at 5K amps.
Legend
X = 30 amp data
+ = 15 amp data
Inches Displacement from TMVT90 = 0 Beam
.800
.700
.600
.500
.400
.300
.200
.100
30 amps Thru
15 amps Thru
100
200
300
400
500
600
Distance from A0 (ft)

Fig 3